E7.3   10 5.4 9.

CTR-/3/653

Bi-Monthly Progress Report

Period: March 1 to April 30, 1973

A.   Title of Investigation: A Study of the Utilization of ERTS-1
                              Data from the Wabash River Basin

B.   Principal Investigator: D. A. Landgrebe
                              GSFC Number UN127

C.   Problems

The only problems reported were from the System Processed versus Scene Processed Digital Data comparison project. Radiometric and geometric errors were found in the Scene Processed CCT data which seriously impairs progress on this project. A detailed discussion of the problems will be presented in the June six month report.

D.   Accomplishments

Crop Species Identification and Acreage Estimation: During March and April we have been working with ERTS MSS data collected over USDA Crop Reporting District No. 9 in Southeast Missouri as part of a cooperative project with the Statistical Reporting Service (SRS) of the USDA. SRS has supplied ground truth information for 45 segments in this nine county area; each contains two to 20 fields. Primary crops in the area are soybeans and cotton with some wheat, hay, and corn. The overall objective is to evaluate the utility of ERTS data for identifying the major crop species; cotton, soybeans, corn, and wheat present in the area.

During this period we have been preparing the data for analysis. This task has included rotating, deskewing, rescaling, and overlaying data from three ERTS passes in August, September, and October, as well as locating segments and fields in the ERTS imagery so that they can be used for training the classifier and testing classification accuracy.

During May and June we will be classifying the data for the project described above.

Mapping of Soil Associations: No report for this project for this period.

Urban Land Use Analysis: Four bands of multispectral data were analyzed by computer processing to classify Marion County, Indiana into several broad land use categories. Initially, the nonsupervised (cluster) method of classification was used, but results were unsatisfactory. Thusly, training samples were chosen by hand

for eight types of urban land use -- 1) single-family residential, 2) multi-family residential, 3) grassy (open, agricultural) areas, 4) trees, 5) commercial/industrial, 6) cloud, 7) cloud shadow, and 8) water -- and the county was classified again.

Specific, statistical investigations were then made into the nature of three types of ground cover -- wooded residential, grassy, and multi-family residential. Statistics were calculated for numerous samples of each of these classes. Although the maximum likelihood classifier had been unable to adequately distinguish between the three, observation of two parameters showed they could be quantitatively separated. All three classes are confused in both visible bands, but wooded residential and multi-family residential are separable in the infrared bands. Both of these classes, however, are confused with grassy in the infrared. Grassy areas are distinguishable, nevertheless, because of 1) a greater variance in the infrared, and 2) a greater correlation between bands 6 and 7.

Work planned for the next two months will include 1) more testing of the above theories, 2) application of statistics from Marion County to Tippecanoe County (within same frame), and 3) land use analysis of Marion County in the January ERTS frame (Scene ID 1177-15593).

Earth Surface Feature Identification: In the past months we have completed the development of a spatial data bank for a sixty-three square mile area of Tippecanoe County, Indiana. Many complex problems arose in the process of converting the base data to machine readable format. A series of EDIT programs were developed in order to test the spatial accuracy of the data and when errors were found the data had to be re-extracted or changed so as to be correct. The data bank consists of forty-seven natural and cultural resource variables. It is stored on a UTM coordinate system which proves to be a very effective system in which to relate one or more variables against others.

We are now in the process of extraction and putting into machine readable format variables that have been extracted from ERTS-1 imagery so as to run comparative analysis studies as to the spatial and quantification accuracy of that data. The first comparison to be made is that of forest cover types as extracted from data obtained on September 30, 1972 and compared to the source data (aerial imagery flown on October 1971). After this test a number of other natural and cultural variables will be compared, utilizing the same methodology in an attempt to determine which of the earth surface feature variables are critical to land use planning and can be directly extracted from ERTS imagery.

Upon the completion of this phase, the intention is to determine the feasibility and success of taking the ERTS data, without having to first classify it and then extract it at another scale, and automatically put the data into the data bank so as to relate it spatially to the already existing variables.

Water Resources Research: Water resources research during the last two months has concentrated on the comparison of data collected by ERTS and by ERIM aircraft scanner system. This work has focused upon the area around Lake Shafer and Lake Freeman north of Lafayette, Indiana. Neither system has shown any significant spectral difference between these two reservoirs. However, spectral differences are present between the center portion and the edge of the reservoirs, and the rivers in the area are spectrally different from the reservoirs.

Analysis of the aircraft data has indicated similar results to those obtained from the analysis of the ERTS data. However, more spectral classes could be defined using the aircraft data. We also encountered some severe sun angle problems in analyzing the aircraft scanner data which were not present on the ERTS data.

Plans for the next reporting period will concentrate on spectral analysis of water bodies over a larger geographic area, as well as to finish and document the current work in the Lake Shafer-Freeman area involving the comparison between aircraft and ERTS scanner data.

Atmospheric Modeling: The ability to extract information concerning surface reflectance from a satellite radiance measurement is enhanced if the atmosphere makes only a minor contribution to the total signal. A means of isolating this unwanted portion of the signal has been devised for the atmospheric model.

Techniques for properly averaging radiance values over the four MSS channels are being developed. This is being done using spectral response curves for the MSS detectors obtained from Dr. Warren Hovis of Goddard Space Flight Center.

During the next period, selection of atmospheric parameters for tests of the atmospheric model will be made. Test cases to study the importance of the atmosphere in the MSS data will be begun.

Analysis Technique Development: No report for this project at this time.

Reformatting and Overlay: Progress in reformatting and overlay will be reported in the semi-annual report. No problems have been

encountered in filling user requests for Sensor Processed CCT data reformatting and temporal overlay of multiple passes over the same area. Experimentation continues on geometric transformation to deskew, rescale and rotate the CCT data. Higher order corrections will be investigated as resources permit. The purpose is to produce computer line printer pictorial printouts of ERTS data which match 1:24000 scale topographic maps to aid researchers in identifying areas of interest in the data.

Comparison of System Corrected and Scene Corrected CCT Data: A discussion of the progress and problems in this project will be reported in the June report. Quality problems in the Scene Processed data have caused re-evaluation of the feasibility of pursuing this project.

E. Significant Results

For the Urban Land Use Analysis Project, classification results were good to excellent for the following classes: Single-family residential, commercial/industrial, cloud, cloud shadow, trees, and water. Grassy areas were defined fairly well, but residential areas located between multi-family residential and single-family residential were misclassified as grassy. Residential areas dominated by tree cover, termed wooded residential, were unable to be classified in a single class. Data points in such areas were classified randomly as either grassy or trees.

F. Publications

Two papers were produced which were presented at the NASA ERTS Program Review.

1. "Identification of Agricultural Crops by Computer Processing of ERTS MSS Data," Marvin E. Bauer, Jan E. Cipra.

2. "Preparation of Urban Land Use Inventories by Machine-Processing of ERTS MSS Data," William Todd, Paul Mausel, Kenneth Wenner.

G. Plans for Next Period

Plans for next period are included in the Accomplishments section for each project.

H. Other

No changes in standing order forms were made. Two image descriptor forms are attached.

ERTS IMAGE DESCRIPTOR FORM
(See Instructions on Back)

DATE __May 7, 1973__

PRINCIPAL INVESTIGATOR __D. A. Landgrebe__   ← PLEASE FILL IN

GSFC __UN 127__

ORGANIZATION __Laboratory for Applications of Remote Sensing__
__Purdue University__

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	Cropland	Cotton	Soybean	
1034-16052	X	X	X	
1034-16055	X	X	X	
1052-16052	X	X	X	
1052-16055	X	X	X	
1070-16052	X	X	X	
1070-16055	X	X	X	

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

MAIL TO   ERTS USER SERVICES
CODE 563
BLDG 23   ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406

GSFC 37-2 (7/72)

DATE _9 May 73_

PRINCIPAL INVESTIGATOR _D. A. Landgrebe_   ← PLEASE FILL IN

GSFC _UN 127_

ORGANIZATION _Laboratory for Applications of Remote Sensing_
Purdue University

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS* Rural Area	Urban Area	Water	DESCRIPTORS
10691S585MX			✓	Pond
"			✓	Reservoir
"			✓	River
"			✓	Stream
"		✓		Industrial area
"		✓		Commercial area
"		✓		Older housing
"		✓		Suburban area
"		✓		Highways
"		✓		Parks
"		✓		Golf courses
"		✓		Wooded suburban areas
"	✓			Cropland
"	✓			Wooded areas
"	✓	✓		Cumulus clouds
"	✓	✓		Cloud shadows
"		✓		Airport

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

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